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U.S. NAVY-MARINE CORPS COMBAT TRAUMA REGISTRY OPERATION IRAQI FREEDOM-1 PRELIMINARY FINDINGS

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U.S. Navy-Marine Corps Combat Trauma Registry Operation Iraqi Freedom-1 Preliminary Findings



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TABLE of CONTENTS

Abstract	ii
Definition of Acronyms.....	1
Introduction.....	1
Approach.....	1
Results	4
OIF-1 Theater Medical Treatment Facility Laydown	4
Patient Profiles from Levels 1 and 2 Medical Treatment Facilities	7
Discussion.....	17
OIF-2 Data Collection Plan	17
References	20

U.S. Navy-Marine Corps Combat Trauma Registry Operation Iraqi Freedom-1 Preliminary Findings

ABSTRACT

The U.S. military services, drawing upon the experiences of civilian trauma systems in monitoring trauma care delivery, have begun to implement their own registries emphasizing injury incidence and severity in a combat environment. The current paper describes the development of the U.S. Navy-Marine Corps Combat Trauma Registry (CTR) and presents preliminary studies and analyses of combat injury patterns and casualty management within the medical chain of evacuation during Operation Iraqi Freedom (OIF). The Navy-Marine Corps CTR is configured as a data warehouse comprised of data sets that describe the events that occur to individual casualties from the point of injury, through the medical chain of evacuation, and on to long-term rehabilitative outcomes. Data was collected from Navy-Marine Corps level 1B, 2 and 3 Medical Treatment Facilities (MTFs) during OIF-1. Data from the official combat period (19 Mar – 14 Apr 2003) were analyzed to show the number, type, and location of Navy-Marine Corps MTFs operational on each day of the conflict. Maps diagramming these data show the gradually expanding MTF theater laydown beginning with two Navy-Marine Corps Level 1B, 2 and 3 facilities on day 1 of the operation to an eventual 14 at the conclusion of the official combat period on day 27. In addition, results are presented that indicate 37.5% of all Navy-Marine casualties evacuated were due to battle injuries, 28.0% were due to non-battle, injuries, 26.7% to disease, 4.4% were unknown, 3.4% were due to mental disorders.

U.S. Navy-Marine Corps Combat Trauma Registry Operation Iraqi Freedom-1 Preliminary Findings

DEFINITION of ACRONYMS

CTR - Combat Trauma Registry
BAS - Battalion Aid Station (Navy-Marine Corps Level 1B facility)
DIS - Disease
EMF - Expeditionary Medical Facility (Fleet Hospital - Navy Level 3 facility)
FRSS - Forward Resuscitative Surgery System (Navy-Marine Corps Level 1B facility)
MTF - Medical Treatment Facility
MVA - Motor Vehicle Accident
NBI - Non Battle Injury
NOS - Not Otherwise Specified
OIF-1 - Operation Iraqi Freedom 1 (Marine Corps Jan-Sep 03)
OIF-2 - Operation Iraqi Freedom 2 (Marine Corps Feb 04 –present)
OEF - Operation Enduring Freedom (Afghanistan)
RPG - Rocket Propelled Grenade
STP - Shock Trauma Platoon (Navy-Marine Corps Level 1B facility)
WIA - Wounded in Action

INTRODUCTION

Traditionally, studies assessing trauma care efficacy in the U.S. Navy-Marine Corps operational setting have relied on hospital deaths as the primary indicator of effectiveness. No large-scale, comprehensive Navy-Marine Corps specific repository existed for records of combat trauma incidents that described the events associated with injury, such as mechanism, use of personal protective equipment, casualty demographic data, injury profile, levels of care where treatment occurred, treatment protocols administered, or ultimate disposition. The U.S. military services, drawing upon the experiences of civilian trauma systems in monitoring trauma care delivery, have begun to implement their own registries emphasizing injury incidence and severity in a combat environment.¹ The current paper describes the development of the U.S. Navy-Marine Corps Combat Trauma Registry (CTR) and presents preliminary studies and analyses of combat injury patterns and casualty management within the medical chain of evacuation during Operation Iraqi Freedom (OIF-1).

APPROACH

The Navy-Marine Corps CTR is a collection of data sets, configured within the design of a data warehouse. This Navy-Marine Corps CTR data warehouse, represents a collection of integrated, yet heterogeneous sources of data organized to perform queries and analyses. Each set of data within the warehouse has a single, unifying characteristic. That single characteristic is that each data set represents some part of the continuum of care and events surrounding that care administered to casualties as they move through the medical chain of evacuation.

Examination of the events surrounding the administration of care for combat casualties, especially in the forward areas, reveals a complex interaction of activities that must be viewed as a whole if the true nature of what actually is occurring to combat casualties in the medical chain of evacuation is to be revealed. Therefore, the Navy-Marine Corps CTR program has developed and implemented a data collection plan that brings together a number of diverse sets of data collected from the point of injury through the course

of convalescent care in Navy hospitals. The current state of the Navy-Marine Corps CTR data warehouse concept consists of six primary sources of data. These sources of data, when taken together, are designed to provide a comprehensive view of the nature of events and the course of care administered to Navy-Marine Corps casualties from the point of injury through to rehabilitative convalescence. A simplified representation of these six sources of data is presented in Figure 1. It can be seen in Figure 1 that the first data set is the Navy-Marine Corps medical theater laydown. This data set identifies each Medical Treatment Facility (MTF) in theater during an operational deployment, the function of each MTF, and the location of each MTF on each successive day of the operation. This data set is important because data from other data sets in the warehouse are used to identify the specific patients seen at each of the MTFs in the laydown for each day that each MTF was operational and receiving patients. These data, among other uses, permit the calculation of the specific patient workload for each MTF, on each day of the operation. Knowledge of the specific patient workload of each MTF permits the estimation of the ideal mix of providers and equipment needed to optimally configure each MTF.

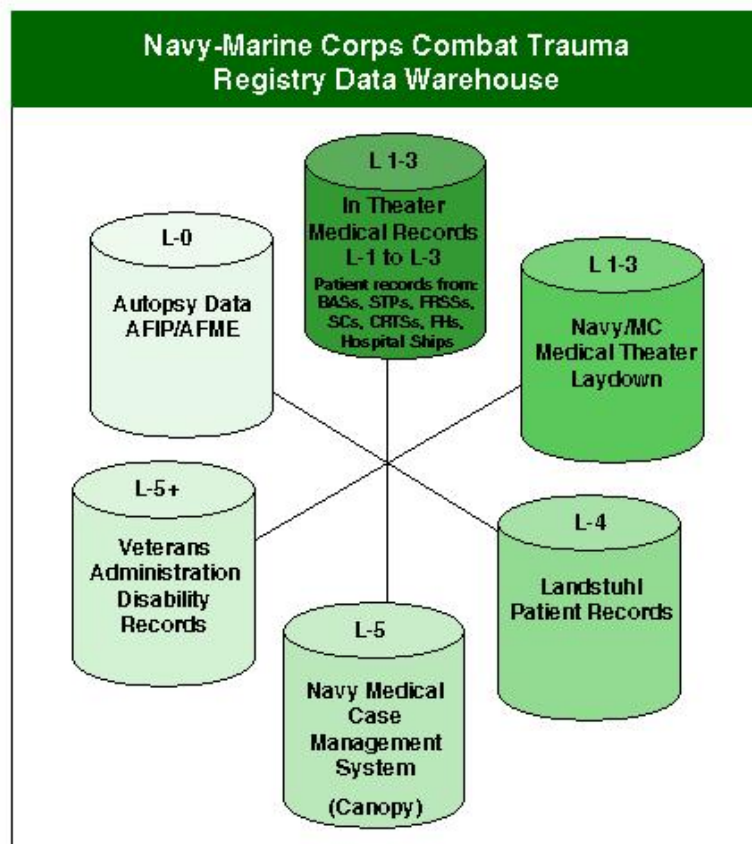


Figure 1: Navy-Marine Corps CTR Data Warehouse

The next component of the Navy-Marine Corps CTR data warehouse concept (Fig. 1) is the most difficult set of data for any service in any nation to assemble. However, this data set, in the opinion of the authors, is the most important element in any CTR. It is the data, primarily clinical in nature, that describes what occurred to the casualty within the *theater* medical chain of evacuation at and near the point of injury. For the Navy-Marine Corps, these are data sets found in the forward areas at level 1-3 MTFs. Within these sets of data are the events surrounding the injury such as mechanism, environmental conditions at the

time of injury, personal protective equipment worn (or not worn), injury profiles, patient status in terms of signs and symptoms, and the course of care administered to the casualty at each MTF in the theater of operation. For the Navy-Marine Corps, these data are obtained from a number of sources and include the first responder (self, buddy, or corpsman), battalion aid stations (BASs), shock trauma platoons (STPs), forward resuscitative surgery systems (FRSSs), surgical companies, casualty receiving and treatment ships, fleet hospitals, and hospital ships. Because of the highly chaotic, and often extreme operational tempo experienced within these facilities, capture of clinical data generally is relegated a low priority. Even when the data are captured, results obtained on the Navy-Marine Corps CTR program have shown that the clinical record is lost somewhere within the medical chain of evacuation and is virtually never reunited with the patient. Therefore, the Navy-Marine Corps CTR program has concluded that capture of these data cannot be conducted retrospectively as originally attempted. A proactive, multifaceted approach to capturing and retaining these data at each MTF in theater is required to collect data near the point of injury in sufficient quantity to be useful. A discussion of the Navy-Marine Corps plan for capturing these data will be presented later in this paper.

The third element of the Navy-Marine CTR data warehouse (Fig. 1) is the data sets derived from level 4 MTFs. In the current deployments of OIF and Operation Enduring Freedom (OEF), most Navy-Marine Corps casualties are processed through the level 4 U.S. hospital at Landstuhl Regional Medical Center, Germany. Data describing the course of care, and associated complications of care are collected at this facility directly from the patient medical record. Because this is generally the first stable, secure, fixed facility in the medical chain of evacuation, complete patient clinical records are available for review. A Navy-Marine Corps CTR registrar is assigned to capture level 4 clinical data and forward it to the Naval Health Research Center in San Diego for inclusion in the Navy-Marine Corps CTR.

The fourth component in the Navy-Marine Corps CTR data warehouse (Fig. 1), is the data sets that describe the course of care and resultant complications of care experienced by casualties once they have arrived at continental U.S. Naval hospitals. Generally, upon arrival to the continental U.S., Navy-Marine Corps casualties are processed through National Naval Medical Center Bethesda (NNMC), Maryland. From NNMC, casualties are transferred to the MTF most capable of providing care appropriate to their condition, closest to their homes or units of origin. Two primary data sets are currently being brought into the Navy-Marine Corps CTR data warehouse. The first of these data sets is the Composite Health Care System II (CHCS II), a U.S. Department of Defense patient management system. Because CHCS II will only provide a partial clinical picture of care performed once the casualties reach the U.S., a second data set, named Canopy, will also be brought into the data warehouse. Canopy is a U.S. Bureau of Medicine and Surgery developed case management system currently operational in all continental U.S. Navy MTFs. Data derived from these two systems will permit the clinical tracking of all Navy-Marine Casualties once they arrive in the U.S.

The fifth component of the Navy-Marine Corps CTR data warehouse (Fig. 1) is the data sets obtained from the U.S. Veteran Affairs administration. This component, currently in the planning stage, will be added to provide disability ratings once casualties have completed their primary recuperative phases. Data from these sources will be used to relate the course of clinical care received early on in the medical chain with long-term rehabilitative outcomes.

The sixth and final component of the data warehouse is the data sets that describe the clinical characteristics from the combat casualty population that were killed in action or died of wounds following entry into the medical chain of evacuation (Fig. 1). This component, still in planning stages, will be used to examine lethality issues within the Navy-Marine Corps, personal protective measures, and for use in models and simulations that forecast mortality estimates for medical planners.

Data from the first two components represents clinical information derived from the forward MTFs. These are the data of most interest to analysts as it is at these MTFs that the developers of the Navy-Marine Corps CTR program expect to effect the greatest benefit. Knowledge of what care was administered at these forward MTFs will be examined in the context of longer term outcome issues such as disability ratings, rehabilitative outcomes, and long-term quality of life issues. To accomplish this objective, the first-order priority for the Navy-Marine Corps CTR has been the capture and analysis of data derived from the forward MTFs. Data for populating the first two components of the CTR began during Navy-Marine Corps operations in OIF.

RESULTS

Preliminary results from the examination of data from the first two components of the CTR will be presented for OIF. Data supporting these results were derived retrospectively from a number of sources including patient clinical records when available, MTF logbooks, Marine Corps Personnel Casualty Reports (PCRs), and ad hoc reporting conducted by MTF clinicians at the individual MTFs. The latter data source, ad hoc reporting at theater MTFs, is a result of clinicians perceiving a need to capture detailed clinical information for latter analysis and making attempts to do so at their MTFs.

The Navy-Marine Corps has participated in two primary deployments in support of OIF. The first, OIF-1, is roughly considered to have occurred from Jan - Sep 2003. The official combat period of OIF is 19 Mar 2003 – 14 Apr 2003. The following results will pertain to the official combat period. The second major Navy-Marine Corps deployment, named OIF-2, began in Feb 2004 and is anticipated to continue for a period of one year. Results for this period are not reported in the current paper.

OIF-1 Theater Medical Treatment Facility Laydown

The first component of the data warehouse calls for development of data sets that describe the specific Navy-Marine Corps MTFs that were operational on each successive day of the operation. These data have been assembled from various data sources including situation reports, medical battalion records, medical facility records, and personal accounts. MTFs for Navy-Marine Corps levels 1B-3 are reported. The level 1B-3 MTFs from OIF-1 presented in the current results include STPs 7-10¹, FRSSs 1-6, Surgical Companies Alpha, Bravo, and Charlie, Expeditionary Medical Facilities (EMF) Pensacola (Fleet Hospital 3), and EMF-Bremerton (Fleet Hospital 8), Rota, Spain.

Figures are presented which describe the medical theater laydown on days when the configuration of the laydown markedly changed. Figure 2 shows the initial medical laydown on day 1 of the official combat period. It can be seen from figure 2 that at the start of the combat period, the major Navy-Marine

¹ Battalion Aid Stations (BASs) are also considered level 1B facilities. These facilities directly support the ground element and are therefore highly mobile. Because of their highly mobile operational characteristic, day by day identification of their positions and patient streams are not currently available for reporting in the theater laydown. Shock Trauma Platoons 1-5 also directly supported the ground element under Combat Service Support Group-11. Data identifying their day by day positions were also unavailable at the time of publication.

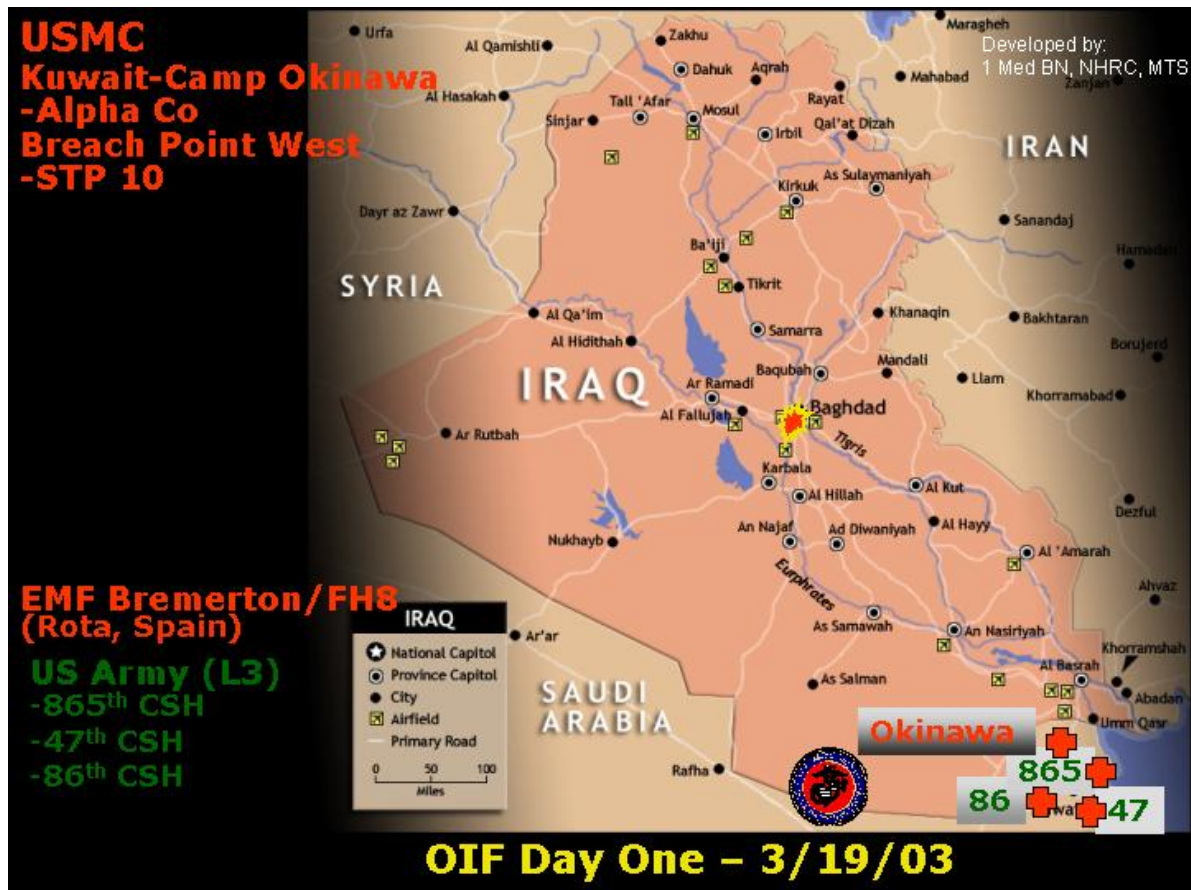


Figure 2: Navy-Marine Corps Medical Theater Laydown on Day 1 of the official combat period.

Corps MTFs operational were EMF-Bremerton (Fleet Hospital 8, Rota, Spain) Alpha Surgical Company in Kuwait and STP -10 near the border at Breach Point West.

By day 17 of the official combat period, additional Navy-Marine Corps MTFs had become operational. Figure 3 shows that in addition to EMF-Bremerton and Alpha Surgical Company (still in Kuwait), EMF-Pensacola, Bravo and Charlie Surgical Companies, FRSSs 1, 4, and 6, and STPs 7, and 8 were now functioning and receiving patients.

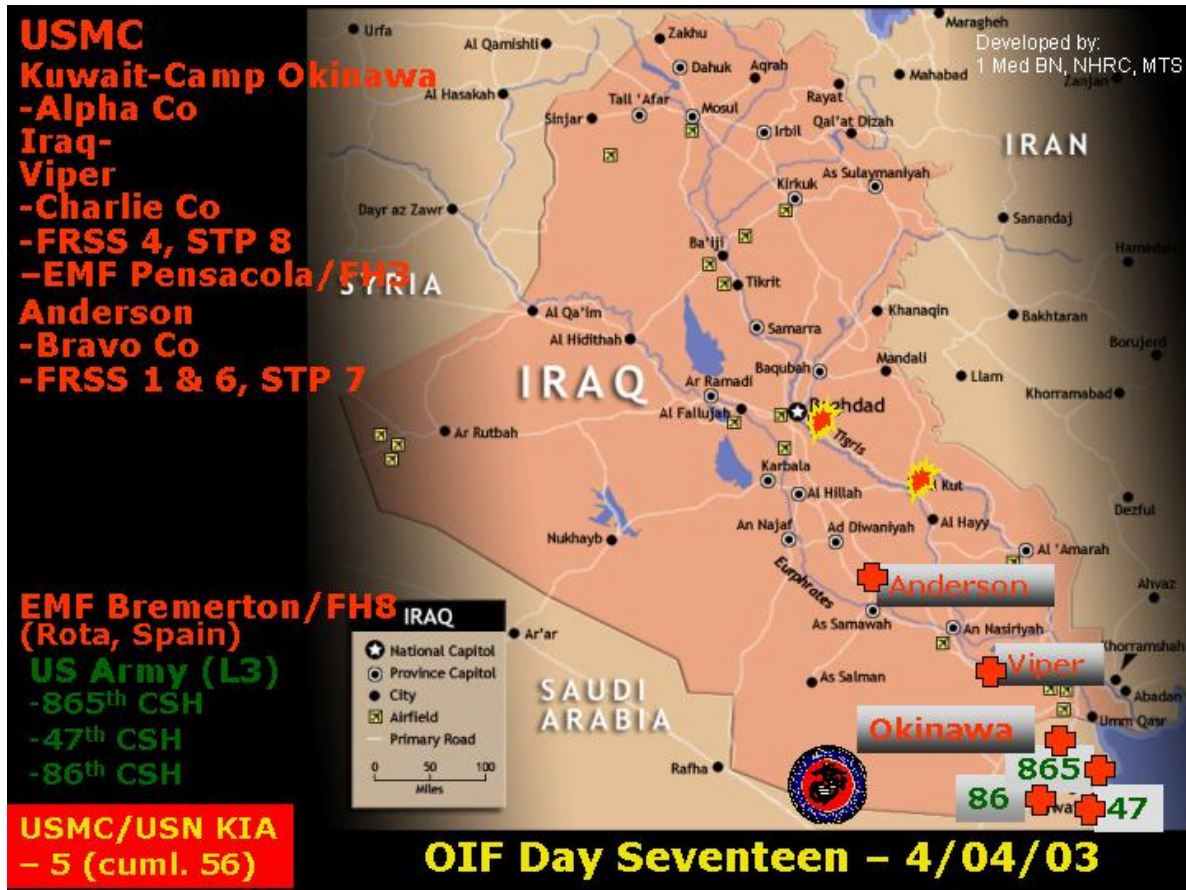


Figure 3: Navy-Marine Corps Medical Theater Laydown on Day 17 of the official combat period.

On the final day of the official combat period (day 27) the full compliment of Navy-Marine Corps MTFs were operational and operating in the positions designated in Figure 4. This compliment of MTFs included two EMFs, three surgical companies, six FRSSs, and the four STPs operating with Health Services Battalion.



Figure 4: Navy-Marine Corps Medical Theater Laydown on Day 27 of the official combat period.

Patient Profiles from Levels 1 and 2 Medical Treatment Facilities

Due to the nature of the events surrounding care in Navy-Marine Corps level 1 and 2 MTFs, gathering data on patient profiles and treatment patterns is allusive. This has historically been the case as little or no data on the course of care in STPs, FRSSs, or Surgical Companies currently exists to any significant degree. The Navy-Marine Corps CTR program has been charged with beginning the process of capturing and preserving data related to the patient stream at these MTFs. It is these kinds of data, found at the level 1-2 MTFs that the comprise the second component of the Navy-Marine CTR data warehouse.

To date, the Navy-Marine Corps has collected records on 1, 406 patients seen during the official combat period at one or more of these MTFs. While these data may be more comprehensive and complete than has historically been possible, they are often partial records. In addition to many partial records, the true number of patients actually seen at these MTFs during the official combat period may never be truly known. This means that not only is the denominator not known at this time, but the nominator data may also never truly be a known commodity. While this unfortunately is the nature of intellectual inquiry in this area of combat casualty care, the sheer volume of data currently captured so overwhelms that available from past operations that they should not be ignored. Rather, the inferences drawn from them should be limited to those areas where the data are strongest and tempered with the expectation that a portion of the picture may not as yet be fully developed.

Given these interpretational parameters, the data on the 1,406 patients seen in level 1-2 MTFs were examined to determine their composition. This population includes evacuations from Level 1B/2 MTFs

and personnel treated at a Level 1B or 2 MTF and returned to duty during the official combat period. Presumably, many of the returned to duty personnel represent sick call visits. Unfortunately, it is believed that the true number of sick call visits during this period is underrepresented due to less thorough record keeping at the MTFs for the sick call population. Given this caveat, Table 1 shows the patient categories seen at Navy-Marine Corps Level 1B/2 MTFs. Table 1 shows that a large impact on Navy-Marine Corps MTFs was attributable to sickcall related encounters for disease conditions. This is remarkable as historically, sick call encounters are generally at their lowest frequency during periods of high operational tempo.

Table 1
Navy-Marine Corps Level 1B/2 Category Types for all Patients
(Evacuated and Returned to Duty)

Navy-Marine Corps OIF-1 21 Mar – 15 May 2003		
	n	%
Disease	538	38.3%
Wounded-in-action	330	23.5%
Non-battle injury	297	21.1%
Injury (unspecified)	171	12.2%
Psych	46	3.3%
Unknown/Not Recorded	24	1.7%
Total	1406	100.0%

Next, this population of 1,406 was examined to assess the primary ICD-9 diagnostic categories. The combination of WIA and NBI in this population is reflected in the high frequency of injuries and accidents. Minimal data is often captured in the return to duty sick call population which is reflected in the high incidence of uncoded encounters and for encounters with no information on the condition for which the patient presented. Table 2 also shows that dental related visits, followed by conditions of the digestive tract were also relatively common at Navy-Marine Corps Level 1B/2 MTFs.

Table 2
Navy-Marine Corps Level 1B/2 Primary ICD-9 Diagnosis for all Patients
(Evacuated and Returned to Duty)

Navy-Marine Corps OIF-1 21 Mar - 15 May 2003		
Primary ICD-9 Category	n	%
Injuries and Accidents	554	39.4%
Musculoskeletal	118	8.4%
Not Coded	94	6.7%
No Information	93	6.6%
Symptoms, Ill-Defined	91	6.5%
Dental	83	5.9%
Digestive	64	4.6%
Infectious and Parasitic	54	3.8%
Mental Disorders	46	3.3%
Miscellaneous	41	2.9%
Skin, Subcutaneous Tissue	34	2.4%
Respiratory	33	2.3%
Nervous System, Sense Organs	32	2.3%
Genitourinary	28	2.0%
Endocrine, Nutritional, Metabolic	14	1.0%
Circulatory	13	0.9%
Neoplasms	7	0.5%
Pregnancy, Puerperium	4	0.3%
Congenital	3	0.2%
Total	1406	100.0%

Additional analyses were conducted on a subset of the 1,406 patients. This subset of 840 patients represents the combined population of patients evacuated from the STPs, FRSSs, and surgical companies Alpha, Bravo, and Charlie during the combat period. This subset was selected because it is a highly comprehensive data set consisting of records representing virtually the full complement of casualties actually evacuated from these MTFs. This was confirmed by matching these patients with records from level 3 and 4 MTFs. Patient profiles and casualty category types for all patients evacuated from the STPs, FRSSs, and surgical companies, during the official combat period are reflected.

Table 3 shows the categories of patients evacuated from combined Level 1B and 2 Navy-Marine Corps facilities during the official combat period. It can be seen that the frequency of Wounded in Action (WIA) patients is consistent with the operational tempo of the reporting period. These data are compared with U.S. Army category types for the same approximate reporting period.

Table 3
Navy-Marine Corps Level 1B/2 and U.S. Army Level 2 Evacuations by Patient Category Types

	21 Mar – 15 May 2003		14 Mar – 30 Apr 2003	
	Marines	Marines	Army ¹	Army ¹
WIA	315	37.5%	108	13.2%
NBI	235	28.0%	208	25.4%
DIS	224	26.7%	205	25.0%
Unknown	37	4.4%	266	32.5%
PSY	29	3.4%	32	3.9%
	840	100%	819	100%

Next, using this same population of Navy-Marine Corps Level 1 and 2 evacuations, an examination of the mechanism of injury, primary IDC-9 category, and primary site of injury was conducted on the WIA group. Table 4 shows the mechanism of injury for each Level 1 and 2 U.S. Navy Marine Corps casualty evacuated to a higher level of care. It can be seen from Table 4 that following gunshots, shrapnel, and RPGs, motor vehicle accidents, occurring in proximal support of an enemy engagement, are relatively high.

Table 4
WIA Mechanism of Injury for Navy-Marine Corps Casualties Evacuated from Level 1B/2 MTFs

Navy/Marines OIF-1 21 Mar - 15 May 2003		
WIA Mechanism of Injury	n	%
Gunshot Wound	76	24.1%
Shrapnel/Fragmentation	65	20.6%
RPG/grenade	39	12.4%
Motor Vehicle Accident	28	8.9%
Fall	17	5.4%
Explosion	16	5.1%
Unknown/Not Recorded	16	5.1%
Landmine	14	4.4%
Blast	11	3.5%
Mechanical/Machinery	13	4.1%
Other	10	3.2%
Multiple (NOS)	4	1.3%
Blunt	3	1.0%
Debris	3	1.0%
Total	315	100.0%

Table 5 shows primary ICD-9 codes resulting from each of the WIA mechanisms of injury. An examination of these data shows that open wounds and fractures are the primary pathologies associated with the mechanisms. It should be noted, however, that because these classifications are considered primary in nature that a certain number of the open wound category could contain additional fractures that appear secondary to the open wounds.

Table 5
WIA Primary ICD-9 Diagnosis for Navy-Marine Corps Casualties Evacuated form Level 1B/2 MTFs

Navy/Marines OIF-1 21 Mar - 15 May 2003		
WIA Primary ICD-9Categories	n	%
Open wounds	162	51.4%
Fractures	55	17.5%
Sprains	24	7.6%
Multiple	14	4.4%
Other	14	4.4%
Amputations	10	3.2%
Burns	7	2.2%
Contusions	7	2.2%
Intracranial injury	6	1.9%
Crushing	5	1.6%
Dislocations	5	1.6%
Unknown	5	1.6%
Effects	1	0.3%
Total	315	100.0%

Table 6 shows the primary anatomical site of injury for Navy-Marine Corps WIA casualties evacuated from Level 1B/2 MTFs. Consistent with the use of body armour is the relatively low incidence of back, chest, and abdomen injuries. Equally consistent is the high rate of injuries for traditionally unprotected areas of the extremities and face.

Table 6
WIA Primary Site of Injury for Navy-Marine Corps Casualties Evacuated from Level 1B/2 MTFs

Navy/Marines OIF-1 21 Mar – 15 May 2003		
WIA – Primary Site of Injury	n	%
Lower Extremities	106	33.7%
Upper Extremities	96	30.5%
Face	27	8.6%
Multiple	24	7.6%
Back	18	5.7%
Head	15	4.8%
Chest	13	4.1%
Abdomen	6	1.9%
Neck	5	1.6%
Other/Unknown	5	1.6%
Total	315	100.0%

Next, the incidences of non-battle injury (NBI) trends were examined in the population of Navy-Marine Corps casualties evacuated from Level 1B/2 MTFs. Analyses were conducted to reveal NBI trends for mechanism of injury, primary IDC-9 category, and primary site of injury. Table 7 shows the results of the examination of NBI mechanisms of injury. It is apparent from Table 7 that less emphasis was placed on identifying the mechanism of injury for NBI at the forward MTFs than was the case for the WIA population. The high incidence of a ‘non stated’ mechanism is unfortunate in this context as the further removed from the point of injury this assessment is made, the less likely that it will ever be determined. Of other interest in these finding is the high rate of motor vehicle accident injuries experienced by the deployed forces during the actual combat period. This population of motor vehicle accidents is distinct from the population reported in the WIA results. However, the reality of separating the WIA from NBI motor vehicle accidents is often a difficult distinction to make.

Table 7
NBI Mechanism of Injury for Navy-Marine Corps Casualties Evacuated from Level 1B/2 MTFs

Navy/Marines OIF-1 21 Mar – 15 May 2003		
NBI Mechanism of Injury	n	%
Not Stated	52	22.1%
Motor Vehicle Accident	43	18.3%
Fall	35	14.9%
Blunt	18	7.7%
Other	16	6.8%
Accidental discharge	14	6.0%
Crush	12	5.1%
Sports	12	5.1%
Training	11	4.7%
Mechanical	10	4.3%
Burns	6	2.6%
Cut/Pierce	6	2.6%
Total	235	100.0%

Table 8 shows primary ICD-9 codes resulting from each of the NBI mechanisms of injury. It can be seen that musculoskeletal injuries predominate in this population with fractures and sprains accounting for a large proportion of evacuations from Level 1B/2 MTFs.

Table 8
NBI Primary ICD-9 Diagnosis for Navy-Marine Corps Casualties Evacuated from Level 1B/2 MTFs

Navy/Marines OIF-1 21 Mar – 15 May 2003		
NBI – ICD Categories	n	%
Fractures	72	30.6%
Sprains	68	28.9%
Wounds	36	15.3%
Other	16	6.9%
Intracranial Injury	10	4.3%
Crushing	10	4.3%
Dislocations	8	3.4%
Burns	6	2.6%
Unknown/Not Recorded	6	2.6%
Amputations	3	1.3%
Total	235	100.0%

Table 9 shows the primary anatomical site of injury for Navy-Marine Corps NBI casualties evacuated from Level 1B/2 MTFs. As was the case seen in the examination of injury site in the WIA population, extremity injuries predominate. Similarly high rates of back, face, and head injuries are consistent with the frequency with which casualties were evacuated due to involvement in motor vehicle accidents.

Table 9
NBI Primary Site of Injury for Navy-Marine Corps Casualties Evacuated form Level 1B/2

Navy/Marines OIF-1 21 Mar - 15 May 2003		
NBI – Primary Site of Injury	n	%
Lower Extremities	93	39.6%
Upper Extremities	71	30.2%
Back	18	7.7%
Face	18	7.7%
Head	14	6.0%
Multiple	7	3.0%
Other/Unknown	6	2.6%
Neck	4	1.7%
Abdomen	2	0.9%
Chest	2	0.9%
Total	235	100.0%

Finally, the incidence of disease was examined in the population of casualties evacuated from Navy-Marine Corps Level 1B/2 MTFs during the official combat period. Table 10 presents these results. Table 10 shows that diseases of the digestive tract predominate in this population. Next, presumably due to the austere diagnostic capabilities of these MTFs, are ill defined symptomologies. A preliminary examination of data currently in house suggests that many of these patients were transferred to one of the two Level three fleet hospitals operating in theater during this period. As the fleet hospital data is examined more thoroughly in the coming months, it is expected that more definitive diagnostic categories will be able to be assigned these patients with reported ill-define symptomologies.

Table 10

Disease Primary ICD-9 Diagnosis for Navy-Marine Corps Casualties Evacuated from Level 1B/2 MTFs

Navy/Marines OIF-1 21 Mar - 15 May 2003		
Primary ICD-9 Disease Categories	n	%
Digestive	44	17.4%
Symptoms Ill Defined	38	15.0%
Mental Disorders	29	11.5%
Musculoskeletal	29	11.5%
Genitourinary	21	8.3%
Nervous System Sense Organs	17	6.7%
Skin	15	5.9%
Supplemental	15	5.9%
Infectious and Parasitic	10	4.0%
Circulatory	10	4.0%
Endocrine, Nutritional	8	3.2%
Neoplasms	6	2.4%
Respiratory	5	2.0%
Pregnancy	3	1.2%
Congenital	3	1.2%
Total	253	100.0%

Among the more comprehensive data sets describing Navy-Marine Corps Level 1B/2 casualties have been obtained from the three Level 2 surgical companies deployed in support of OIF-1. These data describe those patients seen by the Alpha, Bravo and Charlie surgical companies during the official combat period that were subsequently evacuated. Table 11 shows the mechanism of injury for all WIA patients seen at the Navy-Marine Corps Level 2 surgical companies during the official combat period. It is interesting to note that most WIA patients evacuated from Level 1B/2 (n =315) were seen at the surgical companies (n =205) prior to evacuation to the next level of care.

Table 11
WIA Mechanism of Injury for Level 2 Surgical Company Patients

Navy-Marine Corps OIF-1 21 Mar – 15 May 2003		
WIA Mechanism of Injury	n	%
Gunshot Wound	61	29.8%
Shrapnel/Fragmentation	34	16.6%
RPG/Grenade	27	13.2%
Motor Vehicle	17	8.3%
Landmine	13	6.3%
Fall	11	5.4%
Blast	7	3.4%
Explosion	7	3.4%
Other	4	2.0%
Mechanical	3	1.5%
Blunt	2	1.0%
Machinery	2	1.0%
Crush	1	0.5%
Unknown/Not Recorded	16	7.8%
Total	205	100.0%

Table 12 show the primary ICD-9 category for all Navy-Marine Corps patients seen at each of the three Level 2 surgical companies during the official combat period. Table 12 shows that the surgical companies saw primarily WIA and NBI patients during this reporting period.

Table 12
Navy-Marine Corps Level 2 Surgical Company Patients by Primary ICD-9 Category (WIA/NBI/Disease)

Navy-Marine Corps OIF-1 21 Mar – 15 May 2003						
	Alpha Co		Bravo Co		Charlie Co	
	n	%	n	%	n	%
Circulatory	0	0.0%	5	2.0%	0	0.0%
Congenital	0	0.0%	1	0.4%	0	0.0%
Dental	0	0.0%	1	0.4%	0	0.0%
Digestive	6	4.8%	10	4.0%	1	2.2%
Endocrine, Nutritional, Metabolic	1	0.8%	1	0.4%	0	0.0%
Genitourinary	3	2.4%	3	1.2%	1	2.2%
Infectious and Parasitic	0	0.0%	5	2.0%	0	0.0%
Injuries and Accidents	78	62.4%	148	59.9%	27	60.0%
Mental Disorders	4	3.2%	2	0.8%	1	2.2%
Miscellaneous	2	1.6%	6	2.4%	3	6.7%
Musculoskeletal	8	6.4%	19	7.7%	4	8.9%
Neoplasms	0	0.0%	0	0.0%	1	2.2%
Nervous System, Sense Organs	1	0.8%	9	3.6%	0	0.0%
No Information	5	4.0%	1	0.4%	7	15.6%
Not Coded	9	7.2%	14	5.7%	0	0.0%
Pregnancy, Puerperium	0	0.0%	2	0.8%	0	0.0%
Respiratory	3	2.4%	1	0.4%	0	0.0%
Skin, Subcutaneous Tissue	1	0.8%	5	2.0%	0	0.0%
Symptoms, Ill-Defined	4	3.2%	14	5.7%	0	0.0%
Total	125	100.0%	247	100.0%	45	100.0%

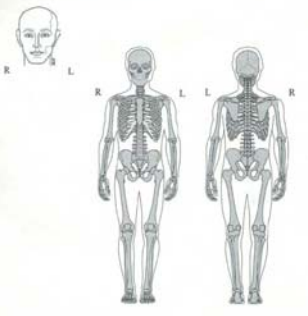
DISCUSSION

The retrospective capture of patient data from theater MTFs close to the point of injury did not result in sufficiently comprehensive data sets to allow for a thorough investigation into the nature of combat casualty care in the forward areas. Due to the chaotic nature of the forward combat casualty care environment, a more structured, prospective process for capturing these data is required. Not only must a structured process be instituted, but it must be facilitated throughout the operational period to ensure that it remains viable and is performed on as many combat casualties as feasible in the chaotic forward MTF environment. Furthermore, to ensure an adequate body of data are captured, the providers responsible for capturing these data must possess knowledge that the data they are collecting will prove useful in improving their ability to successfully manage their patients.

OIF-2 Data Collection Plan

A systematic plan for capturing more robust data sets has been developed and implemented in all Navy-Marine Corps level 1-3 MTFs. The OIF-2 data collection plan includes various methodologies for capturing data that is matched to the operating realities of the individual MTFs.

The CTR Data Collection Form. The plan encompasses the use of four primary approaches to capturing data during OIF-2. The first is the use of the a combat casualty medical encounter form shown in Figure 5. The form used is a modified version of the Theater Trauma Registry form used by U.S. Army MTFs to capture CTR data on patients treated at their facilities. The original intent for the form was to simply fill it out and place it into the patient's medical record and transfer it with the patient. Experience gain on the Navy-Marine Corps CTR program revealed that data captured in theater and sent with the patient through the medical chain of evacuation is generally lost enroute. To remedy this unfortunate reality, the Navy-Marine Corps version of the form was modified. Rather than send the only copy with the patient, the Navy-Marine Corps version of the form was printed to include a self-carboning copy. The providers fill the form out once, placing one copy in the patient medical record and retaining the second copy at the MTF. These second copies are forwarded to the Naval Health Research Center for analyses. This form has been placed in each of the 29 BASs, 3 STPs, 3 FRSSs, 3 surgical companies, and one EMF currently deployed in support of OIF-2.

Theater Medical Registry Record										
MTF Designation: _____ Location: _____		Casualty Name: _____			Casualty SSN: _____					
Time of Injury: _____ DTG _____		Rank _____	Date of Birth _____		Gender <input type="checkbox"/> Male <input type="checkbox"/> Female	Unit _____				
Time of Arrival: _____ DTG _____		Nation <input type="checkbox"/> US <input type="checkbox"/> US Host Nation <input type="checkbox"/> Enemy () <input type="checkbox"/> Coalition ()	Category <input type="checkbox"/> Civilian <input type="checkbox"/> Combatant <input type="checkbox"/> Contractor		<input type="checkbox"/> USA <input type="checkbox"/> SOF <input type="checkbox"/> UN <input type="checkbox"/> NGO () <input type="checkbox"/> USMC <input type="checkbox"/> Other					
Arrival Method: <input type="checkbox"/> Walked <input type="checkbox"/> Carried <input type="checkbox"/> USMC CASEVAC <input type="checkbox"/> DUSTOFF		Non-MED GND <input type="checkbox"/> Ship EVAC <input type="checkbox"/> GND AMB <input type="checkbox"/> DUSTOFF	Protection: <input type="checkbox"/> UNK	Not worn <input type="checkbox"/> Worn	Stitch <input type="checkbox"/> Sutured	Tissue category: <input type="checkbox"/> Immediate <input type="checkbox"/> Delayed <input type="checkbox"/> Minimal <input type="checkbox"/> Expectant				
Transit Duration Time _____		Wounded By: <input type="checkbox"/> Enemy <input type="checkbox"/> Friendly <input type="checkbox"/> Civilian (Host Country) <input type="checkbox"/> Training <input type="checkbox"/> Self Accident <input type="checkbox"/> Self Non-Accident <input type="checkbox"/> Sports Recreation <input type="checkbox"/> Other: _____	<input type="checkbox"/> UNK	Helmet _____	Flak vest _____	Ceramic plate _____	Eye protection _____	Other: _____	Glasgow Coma Scale _____	
Mechanism of Injury: <input type="checkbox"/> Motor Vehicle Crash <input type="checkbox"/> GSW/Bullet <input type="checkbox"/> Blast Trauma <input type="checkbox"/> Single Fragment <input type="checkbox"/> Multi Fragment		<input type="checkbox"/> Aircraft Crash <input type="checkbox"/> Knife-Edge <input type="checkbox"/> CBRENE <input type="checkbox"/> Blast	<input type="checkbox"/> Burns 1 st 2 nd 3 rd _____ %TBSA	<input type="checkbox"/> Crush <input type="checkbox"/> Fall <input type="checkbox"/> IED <input type="checkbox"/> Other	Vitals: _____	Time _____	Temp _____	BP _____	Resp _____	
INJURY Description (Location, nature and size in cm. Be specific.)		Spine _____	TX and Procedures: _____	Sedated _____	Chem Paralyzed _____	Infused _____	CRIC _____	Needle Decompr _____	Chest Tube _____ L R air blood	
		AB Abrasion	AMP Amputation	AV Avulsion	B Bleed	D Deformity	E Erythema	F Foreign Body	F Hematoma	
		LAC Laceration	PW Puncture Wound	P Pain	S Fracture	SS Scaphoid Sign	SW Skin Wound	GSW Gun Shot Wound	Crystalloid _____ LRNS/VETS ml	Tourniquet _____ Time on/off
		Cellul Cellulitis	IO Line _____ ml	Cervical _____	Hemorrhoids (eg. Quick Clot) _____	Oxygen _____ Liters/min	RBC _____ Units	FFF _____ Units	CRYO _____ Units	Phn _____ Packs
		Hernia/Hits _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
		Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
		Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
		Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
		Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
		Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
		Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____	Hypoxia _____
OR Start _____ DTG _____		Vent On _____ DTG _____		ICU In _____ DTG _____						
Provider: _____		Specialty: _____		Date: MM/DD/YY _____						
Medical Visit: <input type="checkbox"/> Sick Call <input type="checkbox"/> Trauma		Treatment: <input type="checkbox"/> Initial <input type="checkbox"/> Follow-Up								

MEDCOM Form Template 1381, JAN 2004/NHRC Revised 2-04

Medications:	Lab:	XRays:	PMH:
Allergies:			
Region	<input type="checkbox"/> Discharge Summary Information (Diagnosis, Procedures and Complications)		
Head & Neck (incl C-Spine)			
Chest (incl T-Spine)			
Abdomen (incl L-Spine)			
Upper Extremities			
Pelvis			
Lower Extremities			
Skin			
Damage Control Procedures? Y / N Hypothermic? Y / N Congulopathy? Y / N Class of Hemorrhage: I II III IV Shock? Y / N			
<input type="checkbox"/> SOAP Note			
<div style="text-align: center;"> (continued on next page) </div>			
DNB Category <input type="checkbox"/> Dermatology <input type="checkbox"/> Head/Cold <input type="checkbox"/> Injury, Other <input type="checkbox"/> Respiratory <input type="checkbox"/> GI Infections <input type="checkbox"/> Injury, Rot./Sports <input type="checkbox"/> Ophthalmologic <input type="checkbox"/> STDs <input type="checkbox"/> Gynecologic <input type="checkbox"/> Injury, MVA <input type="checkbox"/> Psychiatric, Mental <input type="checkbox"/> Fever, Unexplained <input type="checkbox"/> Injury, Work/Tmg <input type="checkbox"/> Psychiatric, Stress <input type="checkbox"/> All Other Medical/Surgical			
Time of Disposition: BYO _____ <input type="checkbox"/> EYD <input type="checkbox"/> Deceased (see below)		Evacuation Priority <input type="checkbox"/> Routine <input type="checkbox"/> Priority <input type="checkbox"/> Urgent	
Time of Death BYO _____ ANATOMIC: <input type="checkbox"/> Head <input type="checkbox"/> Neck <input type="checkbox"/> Chest <input type="checkbox"/> Abdomen <input type="checkbox"/> Pelvis <input type="checkbox"/> Extremity (Upper/Lower) <input type="checkbox"/> Other, specify: _____ PHYSIOLOGIC: <input type="checkbox"/> Breathing <input type="checkbox"/> CNS <input type="checkbox"/> Hemorrhage <input type="checkbox"/> Total Body Disruption <input type="checkbox"/> Sepsis <input type="checkbox"/> Multi-organ Failure <input type="checkbox"/> Other, specify: _____			
Comments: _____ <div style="text-align: right;">Surgeon: _____</div>			

Figure 5. Modified MEDCOM CTR Field Medical Encounter Form.

Laptops. In addition to the CTR data collection forms, laptop personal computers have been placed in each of the forward Navy-Marine Corps MTFs. Among the tools loaded on the laptops is an electronic version of the CTR data collection form. This option is provided for MTF clinicians who prefer filling out the form electronically rather than the traditional paper and pencil method. A communications protocol is installed on each laptop permitting the transfer of the completed forms to the Naval Health Research Center whenever internet communications are available. In addition, an excel spreadsheet has been loaded onto the laptop to provide MTF clinicians with a means of recording a census of the patients seen at their MTF. Due to the nature of the combat environment, not all patients will have a form completed. In these instances, the spreadsheet is provided to record a minimum data set that at the very least captures information documenting that the patient was seen at the MTF. Laptops have been placed in the 29 BASs, 3 STPs, 3 FRSSs, 3 surgical companies and one EMF.

Digital Voice Records. A third data capture methodology, digital voice recorders, have been placed in some of the forward Navy-Marine Corps MTFs. During OIF-1, some success was realized using voice recorders to capture clinical details of care at the FRSSs. This same approach is currently being utilized at each of the 29 BAS, 3 STPs, and 3 FRSSs. Providers at each of these MTFs have the option of recording a core set of CTR data elements on small, handheld digital voice recorders. A small laminated card describing the core data elements required is tethered to each voice recorder for review during the recording of each case. Periodically, the voice recorded files are to be downloaded to the laptops and using an installed communications protocol are transmitted to the Naval Health Research Center for extraction and analysis.

Portable Desktop Copiers. The fourth and final data capture methodology, desktop copiers, have been installed at the more stable forward MTFs including the 3 FRSSs, 3 surgical companies, and 1 EMF. Because the patient record generated at these type of MTFs exceeds the data capture capability of the CTR form, another approach was required to collect details of patient care such as operating room reports and nursing notes. In these more stable facilities, providers are asked to copy the patient record prior to evacuating the patient. Copies of the patient record are retained at the MTF and periodically forwarded to the Naval Health Research Center for analysis.

It is the expectation that by being more proactive and systematic in the capture of Navy-Marine Corps CTR data at the forward MTFs, a more comprehensive view of the events occurring to casualties as they move through the medical chain of evacuation can be assembled than has been historically possible.

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REPORT DOCUMENTATION PAGE

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14. ABSTRACT (maximum 200 words) The U.S. military services, drawing upon the experiences of civilian trauma systems in monitoring trauma care delivery, have begun to implement their own registries emphasizing injury incidence and severity in a combat environment. The current paper describes the development of the U.S. Navy-Marine Corps Combat Trauma Registry (CTR) and presents preliminary studies and analyses of combat injury patterns and casualty management within the medical chain of evacuation during Operation Iraqi Freedom (OIF). The Navy-Marine Corps CTR is configured as a data warehouse comprised of data sets that describe the events that occur to individual casualties from the point of injury, through the medical chain of evacuation, and on to long-term rehabilitative outcomes. Data was collected from Navy-Marine Corps level 1B, 2 and 3 Medical Treatment Facilities (MTFs) during OIF-1. Data from the official combat period (19 Mar – 14 Apr 2003) were analyzed to show the number, type, and location of Navy-Marine Corps MTFs operational on each day of the conflict. Maps diagramming these data show the gradually expanding MTF theater laydown beginning with two Navy-Marine Corps Level 1B, 2 and 3 facilities on day 1 of the operation to an eventual 14 at the conclusion of the official combat period on day 27. In addition, results are presented that indicate 37.5% of all Navy-Marine casualties evacuated were due to battle injuries, 28.0% were due to non-battle, injuries, 26.7% to disease, 4.4% were unknown, 3.4% were due to mental disorders.					
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